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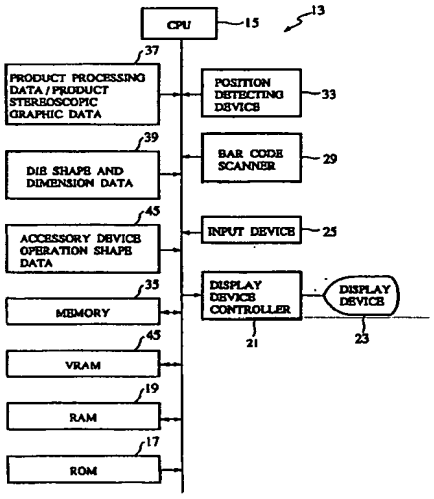
(54) PRESS BRAKE, MOLD LAYOUT DISPLAY METHOD IN PRESS BRAKE, AND INTERFERENCE CHECK METHOD AND APPARATUS

(57) The press brake is provided with a scanner (29) for reading reference numbers and symbols (27A-27D) attached to dies (9A-9D) loaded in the press brake (1), and a position detecting device (33) for detecting a moving position of the scanner (29). The press brake is also provided with a memory (35) for correlating detected position data of the position detecting device (33) and data read by the scanner (29) with each other and storing these, and a display device (23) for displaying data stored in the memory (35). The method for displaying die layout in a press brake includes the steps of (a) displaying dies corresponding to a maximum bend line length of a product to be bent, (b) displaying a diagram and a bend line portion of the product to be bent in an order of bending corresponding to the displayed dies, (c) determining whether it is possible to perform bending by moving the displayed diagram corresponding to the displayed dies or not, (d) registering the dies if a result of determination is YES in step (c) while displaying new dies corresponding to bend line lengths if NO, (e) determining whether it is possible to replace the previous dies by the new dies for bending or not, and (f) changing the registration by erasing the previously registered dies if a result of determination is YES in step (e), while displaying a diagram for next bending by returning to step (b) if No and finishing the process when all the steps for bending are completed.

FIG.2



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Description

Technical Field

[0001] The present invention relates to a press brake. More particularly, the invention relates to a press brake which allows easy selection and laying out of dies during bending of a product by detecting the kinds and layout of the dies loaded in the press brake, indication of the layout of the dies and the details of a workpiece and the product and checking of interference between the workpiece and the dies when the product is to be bent.

Background Art

[0002] Conventionally, where lengths and shapes of a plurality of bent spots in a bent product are different from one another, a plurality of spots in a workpiece have often been bent in sequence with one press brake by loading and properly spacing a plurality of dies in the press brake.

[0003] When a plurality of spots in a workpiece are to be bent by loading a plurality of dies in the press brake, the kinds and layout of the dies to be used are recorded in a work sheet so as to facilitate easy selection of the dies when bending of the same product is carried out again. However, this recording work is burdensome.

[0004] For a new product, a worker must consider the kinds and arrangement of dies according to a bending sequence of the product. It was thus troublesome to select and arrange dies in accordance with bending of a new product.

[0005] It is necessary to check interferences between a workpiece and dies for bending of the workpiece. Traditionally, it was rather difficult to see the workpiece and the dies, because they were stereoscopically shown in a display device.

[0006] Furthermore, when the whole picture of the product and the workpiece was displayed, for instance where the workpiece was long, it was difficult to see the picture because of thin displaying of portions in the vicinity of end parts or feature sections.

Disclosure of Invention

[0007] The present invention was made to solve to the above-noted problems, and the purpose of the present invention is to provide a press brake which allows easy selection and laying out of dies during bending of a product by detecting the kinds and layout of the dies loaded in the press brake, indication of the layout of the dies and the details of a workpiece and the product and checking of interference between the workpiece and the dies when the product is to be bent.

[0008] According to the invention recited in claim 1, a press brake is provided, comprising a scanner for reading reference numbers and symbols given to dies loaded in the press brake and a position detecting device for detecting the moving position of the scanner.

[0009] According to the invention recited in claim 2, the press brake of the first aspect of the invention is further provided with a memory for correlating position data detected by the position detecting device with data read by the scanner and storing these and a display device for displaying data stored in the memory.

[0010] According to the invention recited in claim 3, a method for displaying die layout in the press brake is provided. The method is composed of the following steps: (a) displaying of a die corresponding to a maximum bending length of a product to be processed; (b) displaying of a diagram and a bend line of a bending sequence of the product to be processed corresponding to the displayed die; (c) determination as to whether or not it is possible to perform bending by moving the displayed diagram corresponding to the displayed die; (d) registration of the die if it is determined to be YES in step (c) and displaying of a new die corresponding to the length of a bend line if it is NO; (e) determination as to whether or not it is possible to replace the one for previous bending by the new die; and (f) changing of the registration by erasing the previous relevant die if it is determined to be YES in step (e), displaying again of the diagram for next bending by returning to step (b) if it is NO and completing the whole bending process.

[0011] According to the invention recited in claim 4, a die layout display device is provided in the press brake, comprising a first storage part in which product processing data such as lengths of bending lines, bending sequences and dimensions of bending shapes are stored, a second storage part in which data regarding lengths and dimension of dies is stored, a display device controller for displaying workpiece shapes for each bending sequence by fetching the data from the first storage part and a die corresponding to the bending line length of the workpiece shown in the display device by fetching the dimension data of the die stored in the second storage part and a movement instructing device for providing an instruction to move the workpiece shown in the display device to the display device controller.

[0012] According to the invention recited in claim 5, a method for checking die interferences is provided in a system including a first memory in which stereoscopic graphic data of a product is stored, a second memory in which cross-sectional shape data of a die needed for bending of the product is stored, a display device and a display device controller. The method includes a step of fetching edge shape data of the designated cross-sectional position of the product stereoscopic shape shown in the display device from the first and second memories into the display device controller, and displaying the edge shape of the designated cross-sectional position of the product and the cross-sectional shape of the die in combination in the display device.

[0013] According to the invention recited in claim 6, a method for checking die interferences is provided. The method comprises the steps of: fetching threedimen-

sional shape data of a die and a workpiece and displaying this in a display device; indicating a position for checking workpiece interferences and a sight line direction on a display screen; displaying the shapes of the die and the workpiece in the indicated sight line direction; performing virtual bending of the workpiece on the display screen; and determining whether the sum of the cross-sectional area of the workpiece in the indicated position and that of the die is larger than a fixed number or not, continuing the virtual bending process if its answer is YES, stopping the same if its answer is NO and performing checking of interferences.

[0014] According to the invention recited in claim 7, a method for checking press brake interferences is provided. The method comprises the steps of : fetching three-dimensional data of an object to be interfered with and an object to be observed from a memory and displaying this in a display device; indicating a position of the observed object for performing interference checking and a sight line direction on a display screen; displaying the shapes of the interfered object and the observed object in the indicated sight line direction; moving the observed object toward the interfered object on the display screen; determining whether the sum of the cross-sectional area of the interfered object and that of the designated portion of the observed object is larger than a fixed number or not; and continuing the movement if the result of determination is YES, stopping the movement if NO and checking interferences.

[0015] According to the invention recited in claim 8, a method for displaying long parts by shortening the lengths thereof is provided. The method includes the steps of: displaying long parts in a display device; scanning the shapes of the displayed parts in the longitudinal direction thereof with specified pitches; determining whether coordinate data regarding a line position representing the shapes of the parts is the same as that during scanning of a previous time or not; omitting this data if the result of determination is YES or repeatedly registering the coordinate data if NO; and displaying the long parts by unfolding the registered coordinate data again after completion of scanning.

[0016] According to the invention recited in claim 9, the method for displaying the long parts with the lengths made short as noted in the eight aspect of the invention further includes a step of displaying, when the long parts are to be displayed by unfolding the registered coordinate data again, the parts by magnifying these by a desired amount.

Brief Description of Drawings

[0017]

FIG.1 is a front view of a press brake.

FIG.2 is a functional block diagram illustrating a structure of a controller of a press brake.

FIG.3 is a stereoscopic diagram showing an example of a product.

FIGs.4A-4E are views illustrating a method for displaying die layout.

FIG.5 is a flow chart showing a method for displaying die layout.

FIGs.6A and 6B are views illustrating a display part for checking interferences between a product and a die.

FIG.7 is a flow chart showing another method for checking interferences between a product and a die and a view illustrating the same.

FIG.8 is a flow chart showing a case where a diagram, etc., of a long product are reduced in size in its longitudinal direction.

FIGs.9A-9C are views illustrating a case where a diagram of a long product is reduced in size in its longitudinal direction, displayed by unfolding this again and displayed in an expanded manner.

Best Mode for Carrying Out the Invention

[0018] Referring to FIG. 1, a press brake 1 in an illustrated example is provided with an upper frame 3 and a lower frame 5 placed oppositely to each other in upper and lower parts. Either the upper frame 3 or the lower frame 5 is provided as a movable frame so as to be movable in a vertical direction. A vertical motion actuating device (not shown), for instance a hydraulic cylinder or a servo motor, is also provided to move the movable frame up and down.

[0019] A plurality of punches 9A, 9B, 9C and 9D are attachably/detachably and replaceably attached to the upper frame 3 via a plurality of intermediate plates 7. A die 11 corresponding to one of the punches 9A to 9D is attached to the lower frame 5. In the example, only one die 11 is shown. In actuality, however, depending on the bending shapes of a workpiece (not shown in FIG. 1), a plurality of dies corresponding to the respective punches 9A to 9D are to be attached.

[0020] The press brake 1 is further provided with a controller 13, for instance an NC device or a small computer for controlling each controlled shaft of the press brake 1.

[0021] The controller 13 is, as shown in FIG. 2, provided with a CPU 15. The CPU 15 is connected to a ROM 17, a RAM 19, and a display device 23, for instance, a CRT via a display device controller 21 such as a CRT controller and the like. An input device 25, for instance a keyboard or a mouse, is also connected to the CPU 15 when necessary.

[0022] Bar codes 27A to 27D of reference numbers and symbols representing data regarding the punches 9A to 9D, including their shapes, dimensions, manufacturing dates and die numbers, are attached to the punches 9A to 9D. In order to read these bar codes 27A to 27D, a scanner 29 capable of moving in left and right directions, for instance an image pickup unit or a bar code scanner, is provided.

[0023] More particularly, in the example, the scanner 29 is supported by a guide member 31 provided in the upper frame 3 in left and right directions so as to be movable in left and right directions. In order to detect the moving position of the scanner 29 in the left or the right direction, a linear scale, for instance a magnetic scale, is provided as a position detecting device 33.

[0024] In the above-noted configuration, when the scanner 29 is moved in left and right directions along the guide member 31, its moving position, for instance one from the reference position of a left edge, is detected by the position detecting device 33 and when the scanner 29 comes to each of the bar codes 27A to 27D of the punches 9A to 9D, each of the same is read.

[0025] Data regarding each of the bar codes 27A to 27D read by the scanner 29 and detected position data detected by the position detecting device 33 are correlated with product numbers by the CPU 15 in the controller 13 and stored in a memory 35. The data stored in this memory 35 is displayed in the display device 23 by retrieving the product number.

[0026] Therefore, after the plurality of punches 9A to 9D and the plurality of dies 11 are loaded in order to prepare for bending of a certain product, the arranged positions of the necessary punches and the respective punches can be detected by moving the scanner 29 in the left and right directions along the guide member 31 and reading the bar codes 27A to 27D attached to the punches 9A to 9D. The position data of the respective punches 9A to 9D and data regarding die shapes, dimensions, etc., can be stored in the memory 35.

[0027] When the same product is to be bent again, the dies necessary for this work can be placed in the same positions again by reading data regarding the same product number from the memory 35, displaying this in the display device 23 or printing this by means of a printer, etc., and arranging the dies in accordance with this display or the print. As a result, when bending of the same product is repeated at an interval of some time, it is possible to improve work performance by quickly preparing the dies upon re-machining.

[0028] In the above example, the scanner 29 was moved manually. However, the scanner can be configured to be moved automatically by using a ball screw mechanism, etc., rotated by the linear motor or the servo motor. In addition, the bar codes can be provided in the die 11 sides and the scanner can be provided in the lower side.

[0029] Furthermore, another way of configuration is possible, wherein the controller 13 is properly connected to a host computer (not shown), the position data of the punches (dies) 9A to 9D and data regarding die shapes and dimensions are stored in the memory of the host computer, these data are read out to the controller provided in another press brake connected to the host computer and the position data of the dies (punches) 9A to 9D and the data regarding die shapes and dimensions are utilized in this press brake. This makes it possible to easily lay out the necessary dies when bending of the product bent once is to be performed again.

[0030] The scanners 29 and others noted above are useful for detection of the arranged positions, shapes and dimensions of the dies loaded in the press brake. However, when a product is new, it is necessary to set anew the layout of the dies for bending of this product.

[0031] Thus, the controller 13 in the example is provided with a product data memory 37 connected thereto for storing product processing data including bend line lengths, bending sequences, bent shapes and dimensions, product stereoscopic graphic data according to the bending sequence and the like. A die data memory 39 for storing necessary die data including die shapes and dimensions is also connected to the controller.

[0032] The product data memory 37 and the die data memory 39 may be provided in the host computer. These can be configured to be placed in the RAM 19 of the controller 13 via communication means when necessary. In this case, it is possible to control a memory capacity to be small in the controller 13.

[0033] Referring to FIG. 3, there is shown a case where bending of a product W1 having bent portions FA, FB, FC and FD bent along bend lines A, B, C and D is performed in the order of the bend lines D, C, A and B. A method for displaying the die layout in the display device 23 in such a case will be described below.

[0034] When bending of the product W1 is performed, in step S1, the bend line D having a maximum bending length is retrieved from the data stored in the product processing data memory 37 for the product W1 and first dies (punch and die) P1 and D1 corresponding to the bend line D are displayed in the display device 23 (FIG.4A).

[0035] Then, in step S2, a bending order 1 is set and in step S3, determination is made as to whether the last bending number of times has been reached or not and if YES, the process is finished. In step S3, if the result of determination is NO, the diagram of the bending order set in step S2 and the length of the bend line are displayed between the die P1 and D1 (step S4).

[0036] For the product W1 shown in FIG.3, since the longest is the bend line D and its bending order is first, the dies P1 and D1 corresponding to the length of the bend line D are displayed along with the bend line D (FIG. 4A).

[0037] In step S5, by seeing the display of the dies P1 and D1 and the bend line D as shown in FIG. 4A, determination is made as to whether it is possible to perform bending along the bend line D or not. In this case, since there are no interferences between the dies P1 and D1 and the product W1 and bending along the bend line D can be performed, the process proceeds to step S6, where by operating the input device 25, the dies P1 and D1 are related to the bend line D and registered.

[0038] Then, the process proceeds to step S7, where the bend line C as the second in the bending order is

displayed between the dies P1 and D1 (step S4, FIG. 4B). In this case, since the bent portion FD has been created as a result of bending along the bend line D, this bent portion FD is displayed together.

[0039] Then, in step S5, determination is made as to whether it is possible to perform bending along the bend line C or not. In this case, since there are interferences between the bent portion FD and the dies P1 and D1, the diagram of the product W1 is moved in left and right directions by operating the input device 25 and in the position of the bent portion FD away from the ends of the dies P1 and D1 bending is permitted. The process then proceeds to step S6, where the dies are registered as in the previous case.

[0040] Then, since a third in the bending order is the bend line A, the bend line A is displayed between the dies P1 and D1 with the bent portions FD and FC bent (FIG.4C), the diagram of the product W1 is moved in the left and right directions and determination is made as to whether it is possible to perform bending along the bend line A. In this case, since bending cannot be carried out, the process proceeds to step S8, where by moving the diagram of the product W1 to a position away from the dies P1 and D1, data regarding new second dies P2 and D2 corresponding to the bend line A is read from the die data memory 39 and displayed (FIG. 4C).

[0041] In this case, by using the second dies P2 and D2, it is possible to perform bending along the bend line A. Thus, the process proceeds to step S9, where these dies are registered as in step S6. Then, in step S10, determination is made as to whether it is possible to perform bending along the previous bend lines D and C with respect to the second dies P2 and D2. As the result of determination is NO, the process moves to step S7.

[0042] Then, the process is executed in order to perform bending along the bend line B as a fourth in the order. The diagram of the product W1 is displayed between the first dies P1 and D1 and determination is made as to whether it is possible to perform bending along the bend line B with the dies P1 and D1 or not. If the answer is NO, the diagram of the product W1 is moved to the positions of the second dies P2 and D2. If the result of determination is still NO even with the second dies P2 and D2, by further moving the diagram of the product W1 to the side, third dies P3 and D3 corresponding to the bend line 3 are displayed (step S8, FIG. 4D).

[0043] Thus, the dies P3 and D3 are registered as in step S6 (step S9) and in step S10, determination is made as to whether it is possible to perform bending along the previous bend line D, C and A with these dies P3 and D3 or not. In this case, the bend lines D and C are longer than the bend line B and bending therealong is impossible. However, since the bend line A is shorter than the bend line B, the diagram of the product W1 of FIG. 4C is displayed again corresponding to the third dies P3 and D3 and determination is made as to whether it is possible to perform bending along the bend line A with the third dies P3 and D3 or not. If YES, the process proceeds to step S11, where the second dies P2 and D2 are erased, the bend line A is related to the third dies P3 and D3 and a change is made to the registration.

[0044] When the dies registered in the memory are displayed in the display device 23 after repeating the above-noted operations, the layouts of the first dies P1 and D1 and the third dies P3 and D3 are displayed for the product W1 (FIG.4E).

[0045] Therefore, by loading the necessary dies in the press brake in accordance with the displays in the display device, the dies needed for bending of the product W1 are laid out. This allows easy laying out of the dies.

[0046] In other words, even when a product targeted for bending is new, it is possible to lay out the dies relatively easily.

[0047] As described above, when bending of a product is performed by placing a plurality of dies in the press brake, it is relatively easy to check interferences between the dies and the product if the shape of the product is relatively simple. As a method for carrying out checking of interferences between the product and the dies, one including the steps of stereoscopically displaying the product and the dies and displaying these by changing the colors of interfered portions may be considered. However, if the shape of the product is complex, it may be difficult to see the interfered portions. Also, it may be possible to carry out interference checking, for instance by displaying in combination the side view or the cross-sectional view of the product shape, the side view or the cross-sectional view of the dies. However, in the side and cross-sectional views, a side immediately before a portion targeted for interference checking is simultaneously displayed and thus, it may be difficult to see the interfered portion if the shape is complicated.

[0048] In view of this, the invention provides a novel method for checking interferences. This method will be described hereinbelow.

[0049] Referring to FIG. 6, there are shown a display of the stereoscopic shape of a product W2 made in the display device based on stereoscopic graphical data regarding the product W2 stored in the product data memory 37 and a display of a cut line CL representing the cutting position of the product W2 therein. There is also illustrated a display in combination of the edge shape of the product W2 cut along the cult line CL and the edge shapes of necessary dies 41P and 41D stored in the die data memory 39 in the display device 23.

[0050] In the above-noted configuration, a cut edge shape can be obtained by moving the cut line CL to an optional position of the shape of product W2 stereoscopically displayed. Further, since this edge shape and those of the dies 41P and 41D are displayed together, a diagram displayed for interference checking can be made simple and the interference checking position of the product W2 and the existence of interferences

between the product W2 and the dies can be easily found by eyes.

[0051] It is possible to adopt another approach to checking of interferences between dies and a product as described hereinbelow. Referring to FIG. 7, in step S20, three-dimensional data regarding a product W3 and a die 43 is fetched from the data memories 37 and 39 and in step S21, the product W3 and the die 43 are displayed in the display device 23,

[0052] Then, after the position to be checked for interferences of the product W3 and a sight line direction are indicated by, for instance arrows on the display screen (step S22), the shapes of the product W3 and the die 43 are displayed in the indicated sight line direction (step S23), the bending state of the product W3 is displayed (step S24) and determination may be made as to whether the cross-sectional area T based on the sum of the cross-sectional area of the indicated interference checking position W3C of the product W3 and the cross-sectional area of the die 43 is smaller than the sum of the fixed, independent cross-sectional area Q of the indicated interference W3C of the product W3 and the fixed, independent cross-sectional area R of the die 43 (step S25). If the calculated area T is smaller than the fixed sum of Q and R, then it can be determined that interference has occurred. On the contrary, if the calculated area T is not smaller than the fixed sum of Q and R, then it can be determined that no interference has occurred.

[0053] Therefore, in step S25, if Q+R=T , then virtual bending is continued. However, if Q+R>T , then the process proceeds to step S26, where virtual bending is stopped and checking may be made on the interference position.

[0054] Explanation was made of a case where interferences between the product and the dies are to be checked. In addition, it is possible to check interferences among the dies, the product and accessory devices by fetching data regarding the operations and shapes of such accessory devices as a robot, a manipulator and the like from a memory 45, displaying the diagram of the accessory devices on the display device 23 related to the product W3 and carrying out steps similar to steps S22 to S26 in the previous case.

[0055] Therefore, where a workpiece is to be supplied to the press brake by using a robot, etc., it is easy to check interferences between the robot and the dies, thereby preventing abutting of the robot against the dies.

[0056] The developments of a product and parts and the shape of the whole product may be displayed for bending of the long parts and product. In this case, for example, if a product is long and its aspect ratio is extremely big, the feature portions of the product may be displayed being crashed, making it impossible to accurately recognize the feature portions.

[0057] For this reason, as shown in the above example, the invention provides an approach to clear displaying of feature points regarding the product shapes and the developments even when the product is long.

[0058] More particularly, a video RAM 45 is connected to the controller 13. When a development showing a long product W4 or its bend line is displayed in the display device 23, if its aspect ratio is big and its feature points are crashed, data regarding the shape of the long product W4 is fetched into the video RAM 45 and scanning performed in the longitudinal direction of the product W4 with specified pitches.

[0059] The scanning pitch may be a fixed amount (e.g., based on a desired resolution) or may be variable with the detection and scanning of the feature portions of the part (i.e., a finer scanning pitch may be used to provide a higher resolution when scanning detailed or feature portions of the part).

[0060] That is, in step S30, a first scanning line is set and in step S31, determination is made as to whether scanning has been completed over the entire area of the video RAM 45 or not. Then, in step S32, when the scanning line intersects the development including the bend line or the diagram of the product W4, coordinate data in a position orthogonal to the scanning direction is fetched and in step S33, determination is made as to whether the previous coordinate data and the current coordinate date are identical or not. If identical, the process proceeds to step S34, where the current coordinate data is omitted. Thereafter, the process continues to step S36 to increment to the next scanning line.

[0061] If the current coordinate data is determined not to be identical to the previous coordinate data in step S33, the process proceeds to step S35, where the current coordinate data is temporarily registered in the RAM as the data adjacent to a previous registered data with respect to the longitudinal direction of the product W4. Then, in step S36, by incrementing the scanning line (i) and using a new scanning line, the process is repeated from step S31 to A36. When scanning over the entire area of the video RAM 45 is completed, the process proceeds to step S37, where the diagram is developed again based on the coordinate data registered in step S35.

[0062] As shown in FIG. 9A, since a scanning line L4 intersects the diagram of the product W4 while scanning lines L1, L2 and L3 do not intersect this, a coordinate position in its intersecting location is fetched and temporarily registered in the RAM 19. Then, a coordinate position in the intersection between a scanning line L5 and the diagram is fetched, compared with that for the scanning line L4 and registered in the RAM 19 because it is different. Further, scanning is carried out sequentially for scanning lines L6 and L5, L7 and L6 and L8 and L7, etc., coordinate positions in locations crossing the diagram are compared for the respective cases and only the coordinate positions different from the previous are registered in the RAM 19 as the data adjacent to a previous registered data with respect to the longitudinal direction of the product W4. By transferring and storing

the registered coordinate data from the RAM 19 into the video RAM 45, a view like that shown in FIG. 9B is obtained

[0063] As shown in FIG. 9B, if a displayed diagram is small, by magnifying it by a desired amount , an expanded view like that shown in FIG. 9C is obtained.

[0064] Therefore, when the product W4 and its development is long, if the whole product is displayed with the feature portions crashed, according to the embodiment of the invention, the product W4 can be displayed by shortening its longitudinal direction and expanding the view when necessary, making it possible to recognize the feature portions of the product W4 all at the same time. In other words, it is easy to confirm and understand all the feature portions of the product W4, because not just one portion of the product W4 is expanded and displayed.

[0065] Explanation was made above of a case where scanning was carried out only in the left and right directions by referring to FIG. 9A. However, it is possible to shorten left and right directions and upper and lower directions by scanning in the upper and lower directions after completion of scanning in the left and right directions.

Industrial Applicability

[0066] Apparent from the foregoing, according to the embodiments of the invention, for bending of a product, it is possible to easily lay out the dies in the press brake and it is easy to fetch die layout with respect to the bent product and reproduce this.

[0067] Furthermore, it is easy to check interferences between the product and the dies during bending and even when the product is long, it is easy to confirm and understand all the feature portions of the product.

Claims

1. A press brake comprising:

   a scanner for reading reference numbers and symbols attached to dies loaded in the press brake; and
   a position detecting device for detecting a moving position of the scanner.

2. The press brake according to claim 1, further comprising:

   a memory for correlating detected position data of the position detecting device and data read by the scanner with each other and storing these; and
   a display device for displaying data stored in the memory.

3. A method for displaying die layout in a press brake, the method comprising the steps of:

   (a) displaying dies corresponding to a maximum bend line length of a product to be bent;
   (b) displaying a diagram and a bend line portion of the product to be bent in an order of bending corresponding to the displayed dies;
   (c) determining whether it is possible to perform bending by moving the displayed diagram corresponding to the displayed dies or not;
   (d) registering the dies if a result of determination is YES in step (c), while displaying new dies corresponding to bend line lengths if NO;
   (e) determining whether it is possible to replace the previous dies by the new dies for bending or not; and
   (f) changing the registration by erasing the previously registered dies if a result of determination is YES in step (e), while displaying a diagram for next bending by returning to step (b) if No and finishing the process when all the steps for bending are completed.

4. Apparatus for displaying die layout in a press brake comprising:

   a first storage part for storing product processing data regarding bend line lengths, a bending order and bent shapes and dimensions, etc.;
   a second storage part for storing data regarding die length and dimensions;
   a display device controller for displaying workpiece shapes in each bending order by fetching the data from the first storage part and displaying dies corresponding to bend line lengths of the workpiece displayed in the display device by fetching the data regarding die dimensions from the second storage part; and
   a movement instructing device for giving an instruction to move the workpiece displayed in the display device to the display device controller.

5. A method for checking die interferences for use in a system comprising a first memory for storing stereoscopic graphic data regarding a product, a second memory for storing cross-sectional shape data regarding dies necessary for bending of the product, a display device and a display device controller,

   the method comprising the steps of:
   fetching edge shape data regarding a designated cross-sectional position of a stereoscopic shape of the product displayed in the display device and cross-sectional shape data regarding dies in bending positions from the first and second memories into the display device controller, and

displaying in combination an edge shape in the designated cross-sectional position of the product and cross-sectional shapes of the dies in the display device.

6. A method for checking die interferences, the method comprising the steps of:

displaying three-dimensional shape data regarding dies and a workpiece by fetching this from a memory;
indicating a position for checking interferences with the workpiece and a sight line direction on a display screen;
displaying shapes of the dies and the workpiece in the indicated sight line direction;
performing virtual bending of the workpiece on the display screen;
determining whether a sum of a cross-sectional area of the workpiece in a designated position and a cross-sectional area of the die is larger than a fixed number or not; and
continuing the virtual bending process if a result of determination is YES, while stopping the virtual bending process if a result of determination is No and checking interferences.

7. A method for checking press brake interferences, the method comprising the steps of:

displaying three-dimensional data regarding an object to be interfered with and an object to be observed by fetching this from a memory;
indicating a position for checking interferences for the observed object and a sight line direction on a display screen;
displaying shapes of the interfered object and the observed object in the indicated sight line direction;
moving the observed object toward the interfered object on the display screen;
determining whether a sum of a cross-sectional area of the interfered object and a cross-sectional area of a designated portion of the observe object is larger than a fixed number or not; and
continuing the movement of the observed object if a result of determination is YES, while stopping the movement if NO and checking interferences.

8. A method for displaying long parts in reduced sizes, the method comprising the steps of:

displaying long parts in a display device;
scanning the long parts in a longitudinal direction of the displayed parts shapes with specified pitches;
determining whether coordinate data in a line position representing the parts shapes in a direction orthogonal to a scanning direction is identical to coordinate data during previous scanning or not;
omitting the data if a result of determination is YES, while registering the coordinate data if NO; and
displaying the long parts by unfolding the registered coordinate data again after scanning.

9. The method for displaying long parts in reduced sizes according to claim 8,

further comprising the step of displaying, when the long parts are to be displayed by unfolding the registered coordinate data again, the long parts by magnifying the same by a desired amount.

FIG.1

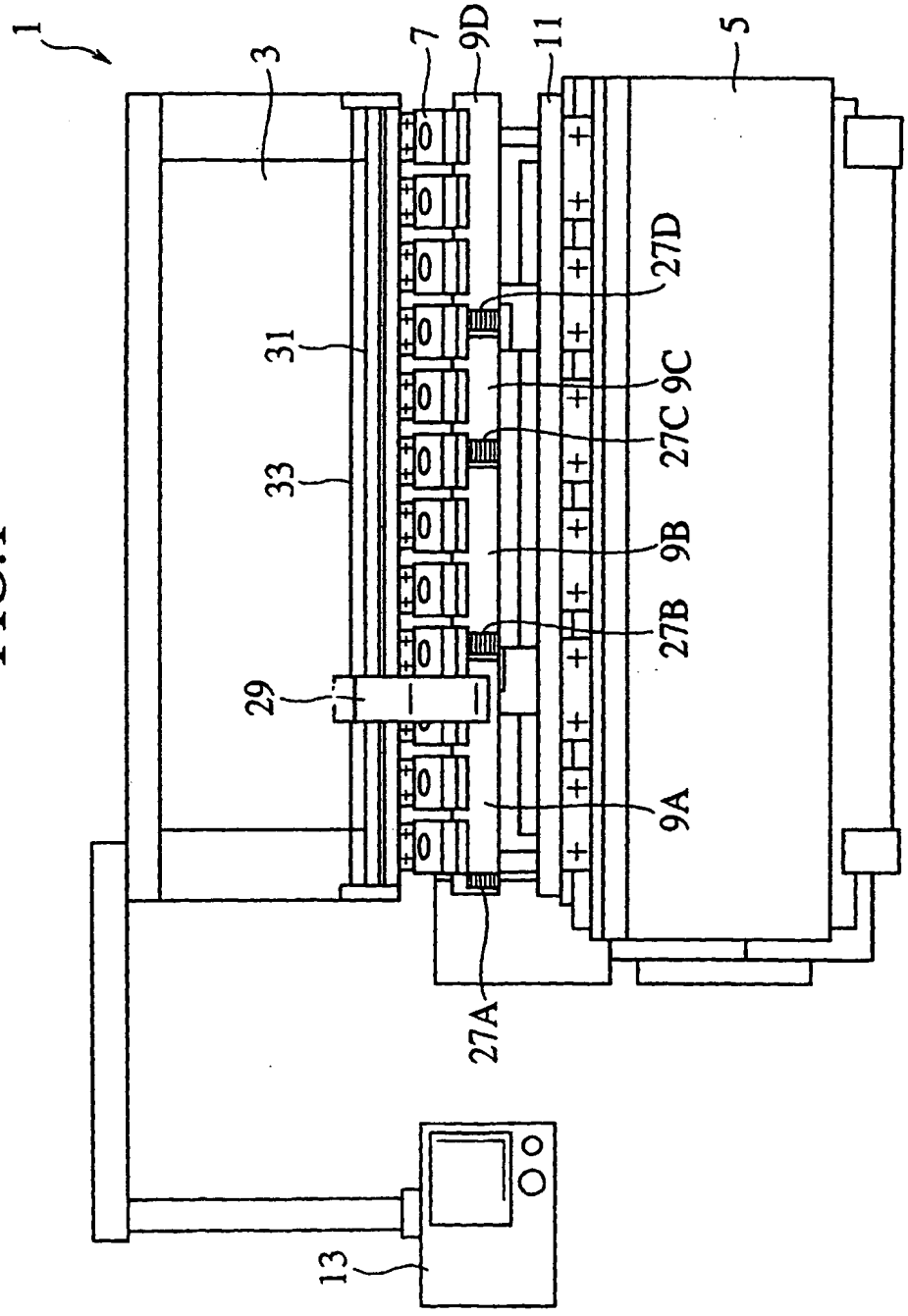


FIG.2

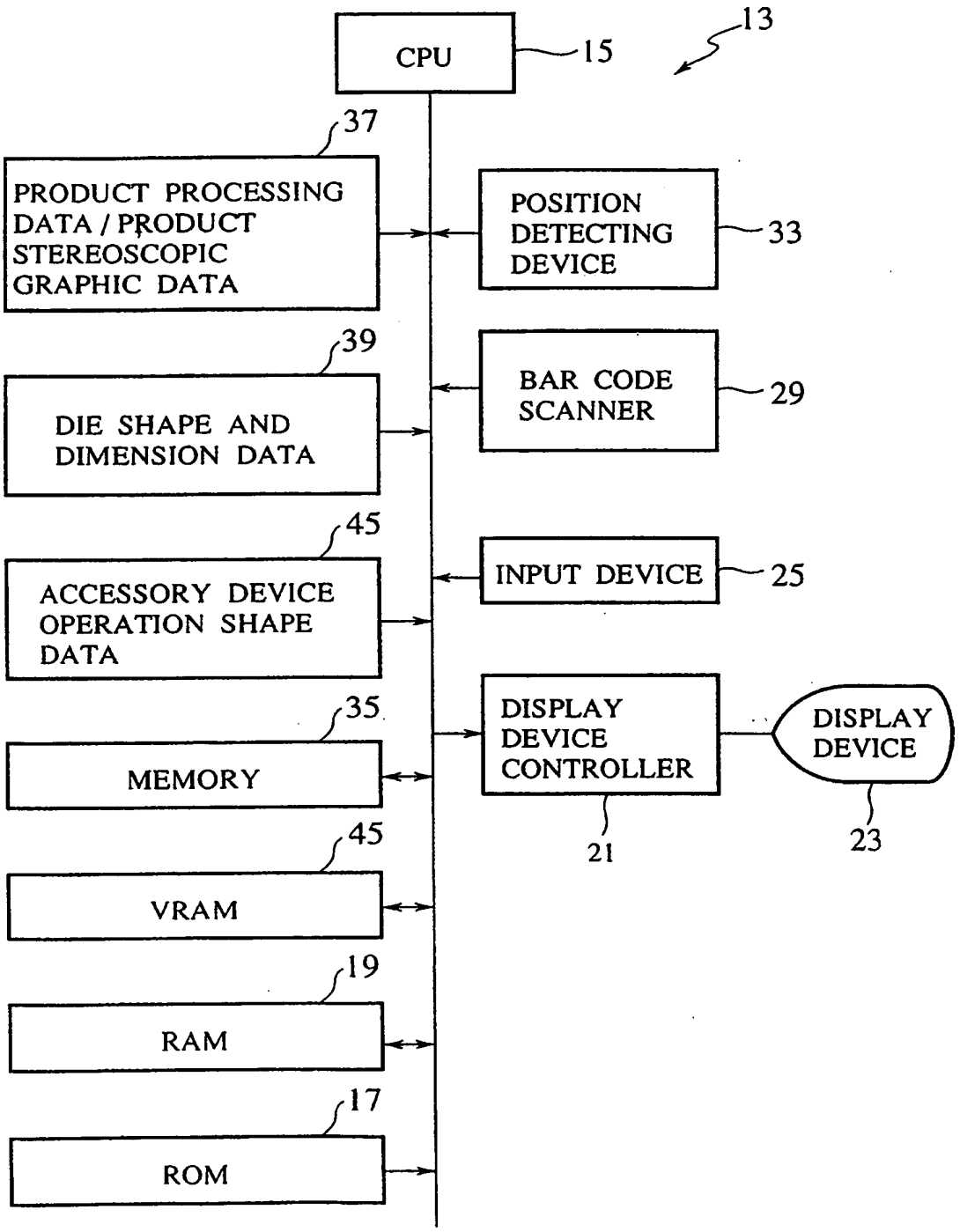

CPU
15
13
37
PRODUCT PROCESSING DATA / PRODUCT STEREOSCOPIC GRAPHIC DATA
POSITION DETECTING DEVICE
33
39
DIE SHAPE AND DIMENSION DATA
BAR CODE SCANNER
29
45
ACCESSORY DEVICE OPERATION SHAPE DATA
INPUT DEVICE
25
35
MEMORY
DISPLAY DEVICE CONTROLLER
21
DISPLAY DEVICE
23
45
VRAM
19
RAM
17
ROM

FIG.3

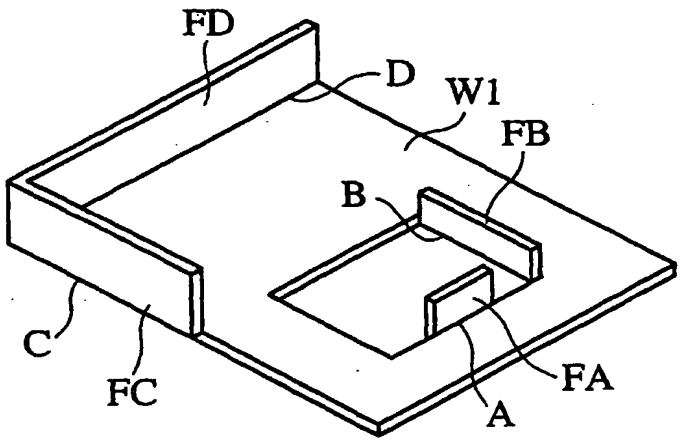


FIG.4A

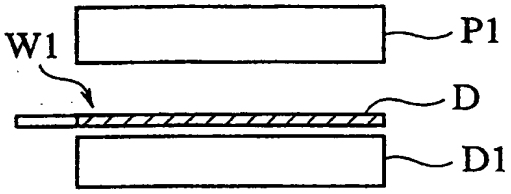


FIG.4B

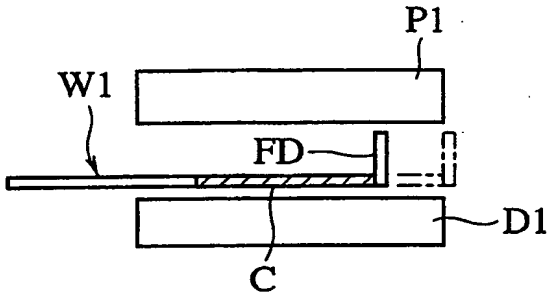


FIG.4C

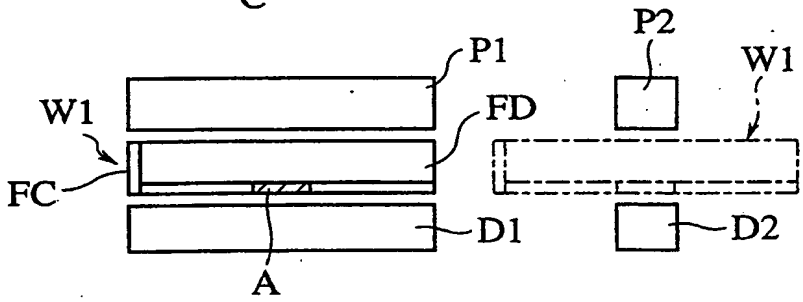


FIG.4D

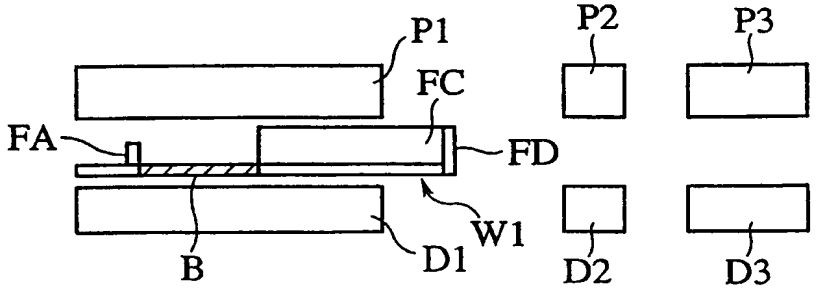


FIG.4E

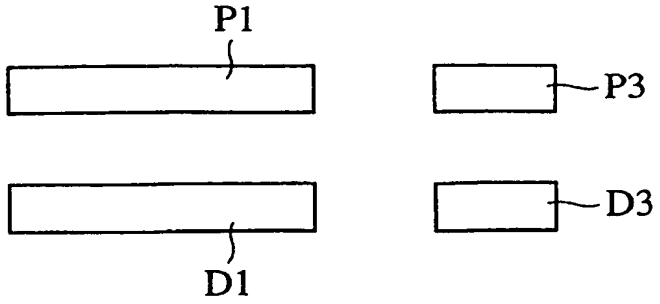


FIG.5

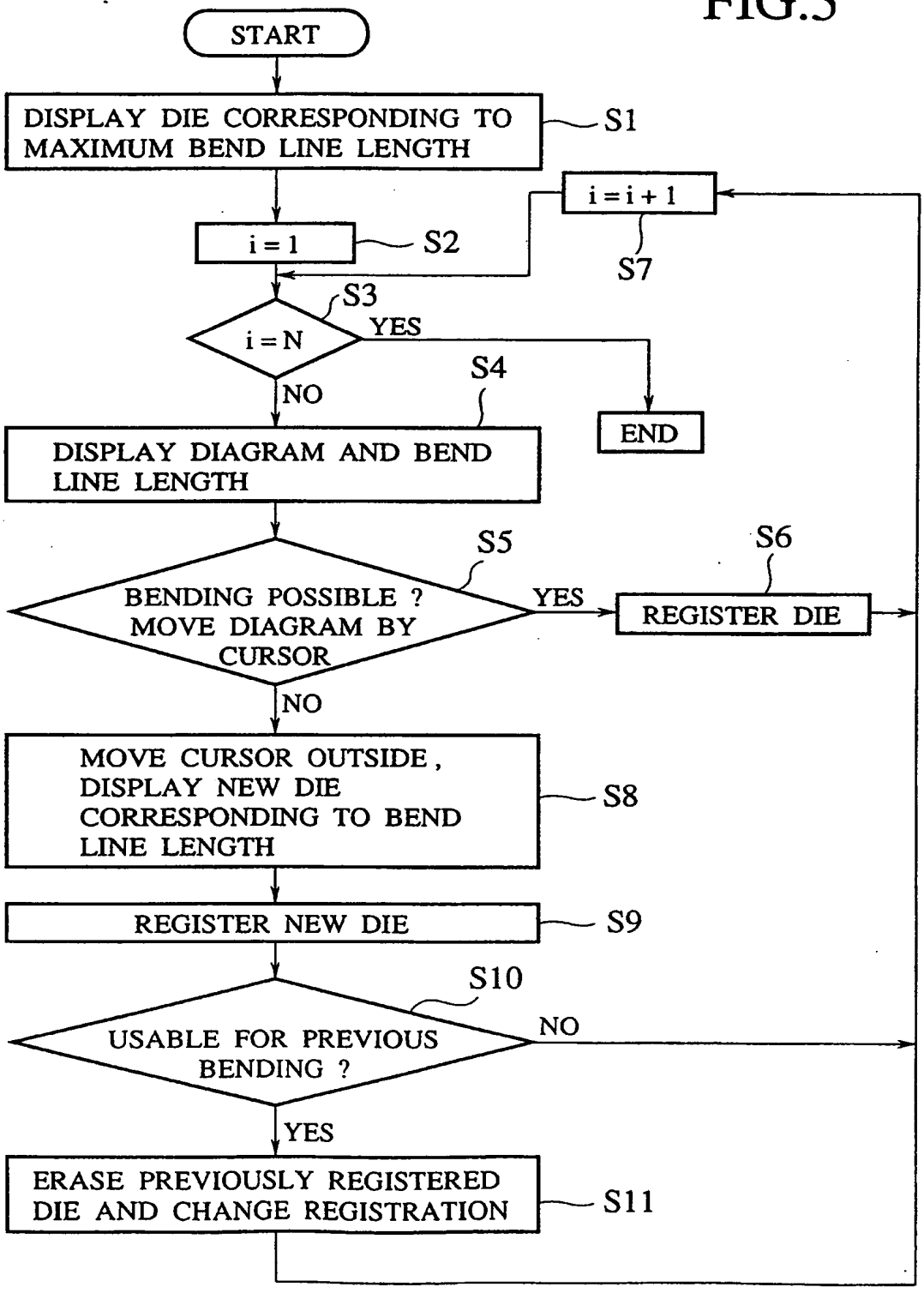

START
DISPLAY DIE CORRESPONDING TO MAXIMUM BEND LINE LENGTH
S1
i = 1
S2
i = i + 1
S7
S3
i = N
YES
NO
S4
END
DISPLAY DIAGRAM AND BEND LINE LENGTH
S5
BENDING POSSIBLE ? MOVE DIAGRAM BY CURSOR
YES
S6
REGISTER DIE
NO
MOVE CURSOR OUTSIDE, DISPLAY NEW DIE CORRESPONDING TO BEND LINE LENGTH
S8
REGISTER NEW DIE
S9
S10
USABLE FOR PREVIOUS BENDING ?
NO
YES
ERASE PREVIOUSLY REGISTERED DIE AND CHANGE REGISTRATION
S11

FIG.6A

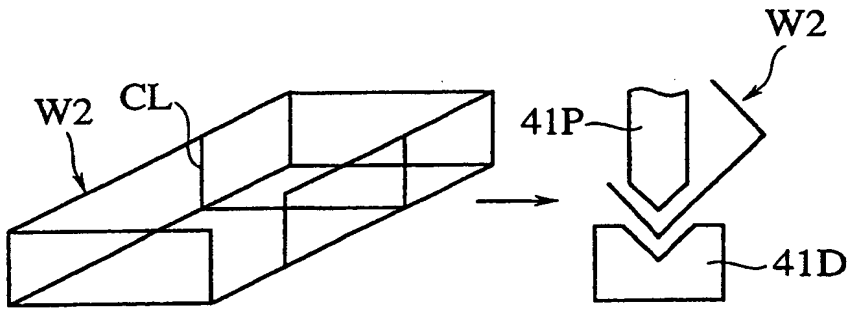


FIG.6B

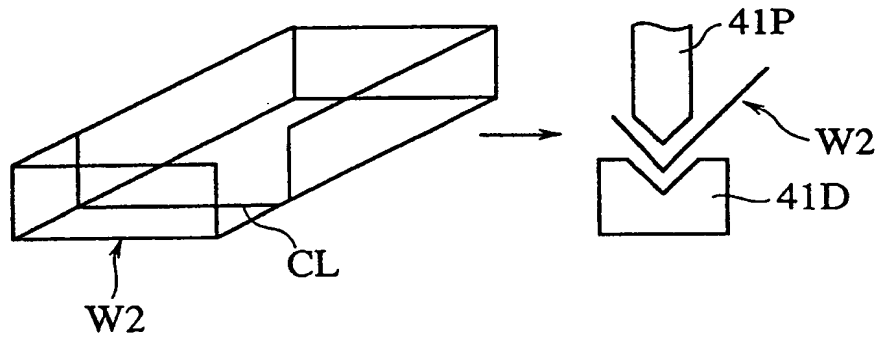


FIG.7

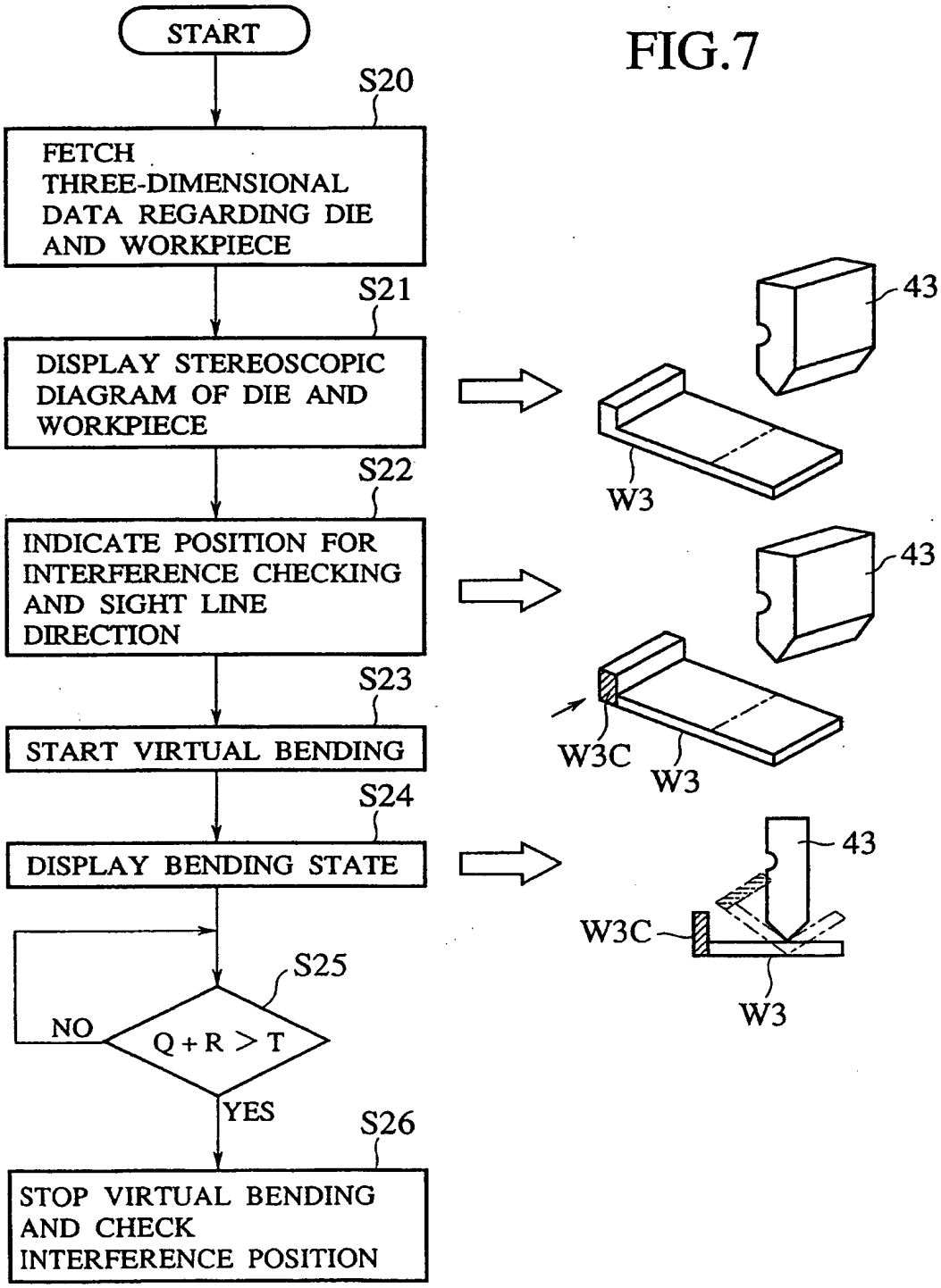

START
S20
FETCH THREE-DIMENSIONAL DATA REGARDING DIE AND WORKPIECE
S21
DISPLAY STEREOSCOPIC DIAGRAM OF DIE AND WORKPIECE
S22
INDICATE POSITION FOR INTERFERENCE CHECKING AND SIGHT LINE DIRECTION
S23
START VIRTUAL BENDING
S24
DISPLAY BENDING STATE
S25
Q + R > T
NO
YES
S26
STOP VIRTUAL BENDING AND CHECK INTERFERENCE POSITION
43
W3
43
W3C
W3
43
W3C
W3

FIG.8

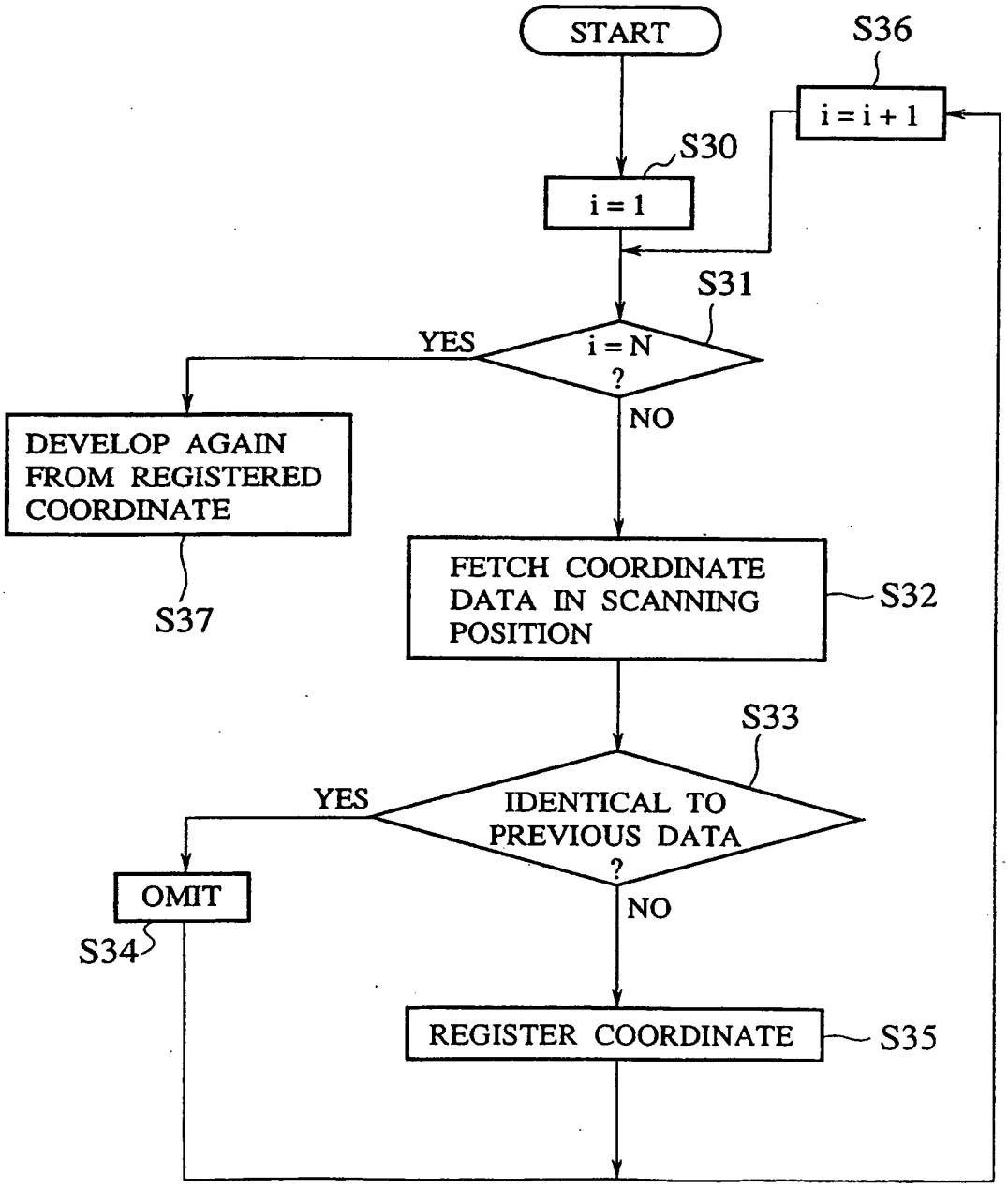

START
S36
i = i + 1
S30
i = 1
S31
YES
i = N ?
NO
DEVELOP AGAIN FROM REGISTERED COORDINATE
S37
FETCH COORDINATE DATA IN SCANNING POSITION
S32
S33
YES
IDENTICAL TO PREVIOUS DATA ?
OMIT
S34
NO
REGISTER COORDINATE
S35

FIG.9A

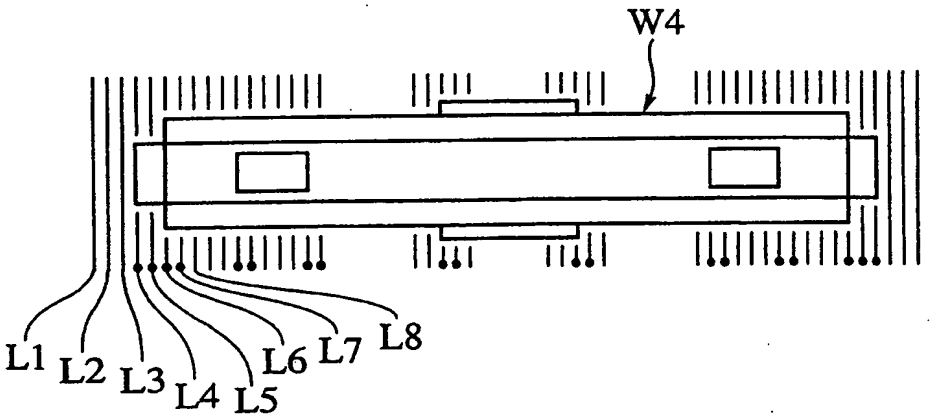


FIG.9B

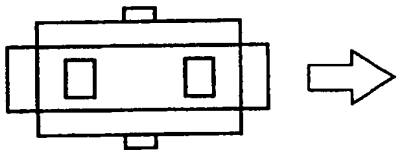
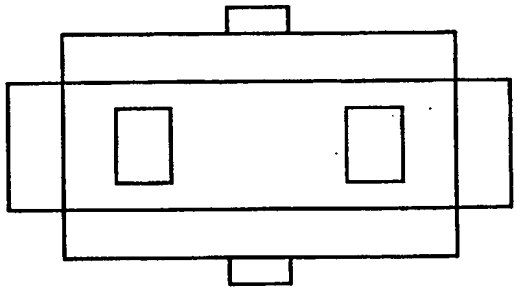


FIG.9C



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP97/02362

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl^6 B21D5/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int. Cl^6 B21D5/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1926 - 1996
Kokai Jitsuyo Shinan Koho 1971 - 1997
Toroku Jitsuyo Shinan Koho 1994 - 1997

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP, 4-22122, U (Amada Co., Ltd.), February 24, 1992 (24. 02. 92), Claim; Figs. 1 to 6 (Family: none)	1 - 2
Y	JP, 5-104169, A (Komatsu Ltd.), April 27, 1993 (27. 04. 93), Claim; Figs. 1 to 3 (Family: none)	3 - 9
Y	JP, 7-56614, A (Sanyo Electric Co., Ltd.), March 3, 1995 (03. 03. 95), Claim; Figs. 2, 3 (Family: none)	3 - 9
A	JP, 63-154230, A (Amada Co., Ltd. and another), June 27, 1988 (27. 06. 88), Claim (Family: none)	1 - 9

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
September 29, 1997 (29. 09. 97)	October 7, 1997 (07. 10. 97)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)